# Improvement of filter capacity through process analysis at Rakha concentrator of Hindustan Copper Limited

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## INTRODUCTION :

Recession is pervading the world during the last several years, which has led to severe slow down in the expansion of mineral industries. In fact, several operations have closed down or curtailed production due to declining metal prices and higher operating costs. India is no exception to these today and matters have been made worse by the falling ore grades. Mineral engineers are now facing new challenges to make the operations more cost effective and economically viable. Thus it has become necessary to introduce better process controls for predictable and sustained improvement from the operations.

In Rakha concentrator, studies conducted and modifications made have given encouraging results and a 30 percent increase in mill throughput has been achieved.

This paper briefly describes the work done on filtration circuit. The data collected by changing the operational parameters have shown that increased filtration rates may be achieved by suitable adjustments. This will reduce running hours of the filter section, which in turn will improve overall economy to a large extent by saving power. In addition this will facilitate to accomodate the extra concentrate produced from mill-flotation circuit.

## Plant description :

The work described in this paper has been carried out at the Rakha concentrator of Hindustan Copper Limited. Its milling and concentrator sections have a treatment capacity of 1000 t/day.

In the crushing plant the 300 mm size boulder is received by dumpers from mines and crushed to –12 mm in three stages. The crushed ore is led off to the mill house which has two identical streams consisting of a ball mill (2.59 × 2.85 m long) in closed circuit with 600 mm diameter hydrocyclone, the overflow of which is sent to flotation section at 25—30 % solids and underflow at 70—75% solids is recirculated back to mills. The flotation section is also equipped with two streams of twelve 1.6 $m^3$ Agitair type rougher cells and four 1.12 $m^3$ cleaner cells of the same type.

The reagents are xanthate and pine oil and consumption rates are 0.02 kg and 0.025 kg/t of ore milled. The final concentrate ( 23—25% Cu ) is pumped to a thickener, the underflow of which at 50 % solids is fed to a 2.4m diameter disc filter. The filter cake with 10—11% moisture is despatched to Moubhandar. The cleaner tails are recirculated back to the conditioner and the rougher tails are sent to mines for back filling after desliming in a 375 mm hydrocyclone.

## Objectives of study :

A 30% increased milling capacity has been achieved by employing two stage classification while the flotation section of the plant is being expanded by installation of extra cells to take care of the extra load from mills. An intensive study was carried out in the dewatering section to avoid the modification required to accomodate the extra concentrate that would be produced since the filtration rate controls the capacity of the dewatering circuit as a whole. Attention was paid to improve upon the filtration rate.

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**Method of sampling :**

In the filter section the sample campaign was carried out to determine :

a) the effect of pulp density on filtration rates.

b) effect of cake thickness on moisture in cake. During the campaign the vacuum was kept constant as far as practicable, around 450 mm. Data were collected for sets of pulp density values e.g. 1.4, 1.5 and 1.8. With each pulp density value 5 sets of readings were taken. The data collected in Table—1 were used to determine :

i) Filtration rate

ii) Cake thickness

iii) Percent moisture.

**Table—1 : Filter performance with cotton cloth vacuum—450 mm**

| Pulp density | Filtration rate ( t/hr/$m^2$ ) | Cake thickness ( cms ) | Moisture (percent) |
|---|---|---|---|
| 1.40 | 0.30 | 1.62 | 9.20 |
| 1.40 | 0.32 | 1.60 | 9.20 |
| 1.42 | 0.32 | 1.65 | 9.14 |
| 1.42 | 0.30 | 1.72 | 9.28 |
| 1.40 | 0.31 | 1.68 | 9.25 |
| 1.50 | 0.47 | 1.98 | 10.10 |
| 1.48 | 0.50 | 2.05 | 10.30 |
| 1.50 | 0.49 | 2.00 | 10.00 |
| 1.50 | 0.50 | 2.08 | 10.05 |
| 1.51 | 0.50 | 2.06 | 10.04 |
| 1.80 | 0.60 | 2.40 | 10.35 |
| 1.80 | 0.66 | 2.55 | 10.50 |
| 1.78 | 0.63 | 2.80 | 10.75 |
| 1.80 | 0.64 | 2.90 | 10.90 |
| 1.80 | 0.65 | 2.85 | 10.85 |

**Analysis of data and discussion :**

It can be observed from Table—1 that :

a) with increase in pulp densities the filtration rate increased.

b) with increase in pulp densities the moisture is increased.

c) with increase in pulp densities the cake thickness is also increased.

While analysing the data of Table—1 it can be observed that at higher pulp densities, higher filtration rates could be achieved but at the same time the moisture content also increases. Moreover maintaining 1.8 pulp density was difficult due to pumping problems—thus a limiting condition had reached at around 1.5 pulp density.

To improve upon the filtration rate without increasing moisture content in the cake, the alternatives available were :

a) to increase vacuum.

b) to increase filter speed.

c) to use different filter media.

Whereas (a) and (b) are difficult to achieve in an operating plant, employing a different filter medium is considered to be an attractive proposition. It was then decided to use "Nylon filter cloth" (NFC) on a trial basis.

Data were collected with nylon filter cloth in a fashion similar to that for cotton cloth. The data is given in Table—2.

Analysing the data from Table—2 it can be observed that :

a) for the same pulp density the filtration rate has increased.

b) the moisture in the cake is less than that with cotton cloth for the same pulp density.

**Table—2 : Filter performance with nylon cloth, vacuum—450 mm**

| Pulp density | Filtration rate ( t/hr/$m^2$ ) | Cake thickness ( cms ) | Moisture (percent) |
|---|---|---|---|
| 1.39 | 0.33 | 2.91 | 8.60 |
| 1.42 | 0.32 | 2.34 | 8.90 |
| 1.38 | 0.34 | 2.45 | 8.95 |
| 1.42 | 0.34 | 2.46 | 8.55 |
| 1.40 | 0.35 | 2.65 | 8.95 |
| 1.50 | 0.56 | 2.85 | 9.55 |
| 1.52 | 0.57 | 2.96 | 9.70 |
| 1.48 | 0.54 | 2.95 | 9.40 |
| 1.50 | 0.56 | 3.05 | 9.75 |
| 1.50 | 0.55 | 2.98 | 9.65 |
| 1.80 | 0.71 | 3.00 | 10.05 |
| 1.78 | 0.74 | 3.10 | 10.15 |
| 1.82 | 0.72 | 3.15 | 10.10 |
| 1.80 | 0.72 | 3.05 | 10.01 |
| 1.80 | 0.70 | 3.00 | 10.20 |

c) further increase of filtration rate without significantly increasing moisture is possible provided pumping high density pulp does not become a bottleneck.

**Conclusions :**

From Table—2, it is clearly established that :

a) for the optimum performance of the filter circuit, the system should be operated 1.5 to 1.6 pulp density with 450 mm vacuum.

b) then it was thought to reduce running hours further by changing filter medium since the use of nylon cloth gave higher filtration rates without increasing the moisture in the cake, the cotton filter cloth was replaced by the nylon cloth. The filter running hours were thus brought down to around 6hr./day.

c) further improvement in filtration rate is possible with nylon filter cloth if higher density pulp can be handled in pumping.